

AN ELECTRONIC CONNECTOR TERMINAL

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electronic connector terminal, and particularly relates to an electronic connector terminal produced by punching a thin metal plate in a desired shape followed by plating with Au.

DESCRIPTION OF THE RELATED ART

An electronic connector terminal is generally formed by punching an electrically conductive thin plate to a predetermined shape. Such an electronic connector terminal usually comprises planer parts defined by front and back faces of a punched out piece and lateral parts defined by a cut-out plane through punching of the thin plate. Generally the electronic connector terminal is categorized to two kinds of terminals; one is a terminal disposed such that the planer part of the thin plate includes a connection to the connection housing when inserted to a connector housing, and another is a terminal disposed such that the lateral part includes a connection to the connector housing when inserted to a connector housing. The terminal, which is configured to have the connection point on the lateral part, has advantages in which the terminal is easier to maintain contact pressure required to the terminal than

1 the terminal configured to have connection point on the planer part
2 and in which the terminal can be disposed in a narrow pitch.

3 Generally, an electronic connector terminal is applied with
4 plating on surfaces of the terminal so as to prevent degradation of
5 connector performance due to oxidation under atmosphere of usage
6 circumstance or electric contact mechanism while enhancing
7 electrical conductivity. Conventionally, in the terminal
8 configured to have the electronic connection on the lateral part,
9 the electronic plating is provided on the entire surface of the
10 terminal, and therefore, there is a drawback in which much amounts
11 of gold (Au) used for plating thereof are required so that the
12 product cost thereof becomes high.

13 With respect to the above drawback, the terminal with plating
14 only on the connection point of the lateral part has been proposed.
15 For example, the method comprising following steps has been
16 proposed in Japanese Patent (Laid-Open) No. Showa 49-114796 and the
17 steps are:

18 stacking a plurality of connector terminals; and
19 plating thereon such that un-necessary plating layers can not be
20 deposited on planer part of a fork-shaped spring.

21 The planer part may be oxidized during long terms usage and
22 the connector performance thereof may be degraded even though the
23 planer part is not subjected to the circumstance easy to be
24 oxidized than the circumstance of the lateral part. With respect
25 to this problem, a contact element with covered planer part with an

1 insulation film has been proposed in Japanese Utility Model (Laid-
2 Open) No. Heisei 5-90834. This contact element is formed by
3 masking the part on which the insulator film is not deposited, and
4 thereafter, dipping the contact in fluorine-system resin solution
5 to form the insulation film thereon.

6 However, the above process requires a masking step in which
7 the contact including the plating layer must be masked after Au
8 plating of the contact portion followed by dipping in the fluorine-
9 system resin solution thereby increasing product costs because
10 additional production processes are required and process steps are
11 increased while wasting time and elaboration as well as
12 requirements for masking materials and the fluorine-system resin
13 solution.

14 Therefore, a terminal which is produced easily and
15 inexpensively by reducing amounts of Au necessary for plating
16 without requiring additional production processes are required so
17 far.

18 19 SUMMARY OF THE INVENTION

20 Regarding to the above problem, an object of the present
21 invention is to provide an electronic connector terminal which is
22 produced easily and inexpensively by reducing amounts of Au
23 necessary for plating without requiring additional production
24 processes, and is able to maintain sufficient contact pressure even
25 when the terminal width is narrowed.

1 The above object may be achieved by providing the electronic
2 connector terminal according to the present invention. That is,
3 according to the invention of claim 1, an electronic connector
4 terminal may be provided. The terminal comprises a terminal base
5 material formed by punching a metal thin plate and an Au plating
6 layer covering the terminal base material, the terminal base
7 material further comprising a lateral part having at least one
8 contact and defined as a cut surface of the thin plate through the
9 punching and a planer part defined by front and back faces of a
10 punched-out piece of the thin plate, wherein a thickness of an Au
11 plating layer covering the planer part is thinner than a thickness
12 of an Au plating layer covering the lateral part having the at
13 least one contact.

14 According to the invention of claim 2, the electronic
15 connector terminal may be provided in which the terminal is
16 characterized in that a ratio of the thickness of the Au plating
17 layer covering the lateral part and the thickness of the Au plating
18 layer covering the planer part is to be from about 10:1 to 5:1.

19 According to the invention of claim 3, the electronic
20 connector terminal may be provided in which the electronic
21 connector terminal comprises a liner plating layer formed between
22 the terminal base material and the Au plating layer so as to cover
23 the terminal base material.

24 According to the invention of claim 4, the electronic
25 connector terminal may be provided in which a thickness of a liner

1 plating layer covering the planer part is thinner than a thickness
2 of a liner plating layer covering the lateral part having the at
3 least one contact.

4 According to the invention of claim 5, the electronic
5 connector terminal may be provided in which a ratio of the
6 thickness of the liner plating layer covering the lateral part and
7 the thickness of the liner plating layer covering the planer part
8 is to be from about 10:1 to 5:1.

9 These and other objects, features and advantages of the
10 present invention will become more clear when the drawings as
11 well as the detailed description are taken into consideration.
12

13 BRIEF DESCRIPTION OF THE DRAWINGS

14 For a fuller understanding of the nature of the present
15 invention, reference should be had to the following detailed
16 description taken in connection with the accompanying drawings in
17 which:

18 Fig. 1 shows a perspective view of the terminal stack which is
19 formed by connecting plural electronic connector terminal of the
20 present invention.

21 Fig. 2 shows a ply of the plural terminal stacks.

22 Fig. 3 shows an Au plating process where plural terminal
23 stacks are dipped in a plating bath.

24 Fig. 4 shows a cross sectional view of the electronic
25 connector terminal of the present invention formed by punching a

1 thin plate and then applying Au plating thereon.

2 Like reference numerals refer to like parts throughout the
3 several views of the drawings.

4
5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

6 Now, the present invention will be explained in detail with
7 referring to drawings, however, the present invention can not be
8 limited to the particular embodiments described hereinafter. Fig.
9 1 shows a perspective view of the terminal stack. The terminal
10 stack 1 has a structure that a plurality of terminal base material
11 2 is integrated to one carrier 3. The terminal base material 2 is
12 formed by punching a metal thin plate. The electronic connector
13 terminal of the present invention is produced by subjecting the
14 terminal stack 1 to Au plating thereafter cutting the carrier 3 to
15 separate individual base materials. Here, the term "terminal base
16 material" is defined as a terminal part formed by punching the thin
17 plate prior to Au plating except the carrier 3. The terminal base
18 material 2 comprises a lateral part 4 formed by a cut surface by
19 punching the thin plate and a planer parts 5 formed as front and
20 back faces of the punched piece. A contact 6 is disposed to one
21 end of the lateral part 4 and the contact 6 is urged by pressure to
22 a connection terminal of an electrical member (not shown). In the
23 embodiment shown in Fig. 1, two contacts 6 are provided thereto.
24 In addition, a leg part 7, which is to be soldered to a substrate

1 to which an electric connector (not shown) is placed, extends from
2 the lateral part 4 of the terminal base material 2.

3 The thin metal plate used as the terminal base material 2
4 shown in Fig. 2 may include copper alloy such as helium-copper and
5 phosphor bronze or electrically conductive metal such as aluminum
6 with the thickness thereof between 0.1 mm and 0.3 mm. A shape
7 through the punching press may be determined depending on a shape
8 of a connection terminal.

9 Holes 8 for carriage are formed with remaining a predetermined
10 spacing in the carrier 3 as shown in Fig. 1 so as to insert a
11 carrier bar (not shown) therethrough with adequate flexibility.
12 The electronic connector terminal of the present invention is
13 generally produced by the steps of: plural terminal stacks 1 are
14 plied, thereafter the carrier bars are inserted to the carrier
15 holes 8 so as not to come off the terminal stacks from the carrier
16 bar, then the plating process described below is subjected thereto,
17 the Au plating layer is formed on each of the plurality of the
18 terminal base materials 2, and then the terminal stack 1 is cut
19 apart from the carrier 3 to provide individual terminals. Then
20 each of the terminals is inserted to a connector housing.

21 In the present invention, a liner plating layer such as a
22 nickel plating layer may be disposed between the thin metal plate
23 and the Au plating layer. The liner plating layer may be deposited
24 to cover the terminal base material 2. The nickel plating may be

1 used to provide gloss effect and to harden the plating surface as
2 well as to provide anti-oxidation effect for the thin metal plate.

3 The electronic connector terminal of the present invention is
4 covered by the Au plating layer in the entire portion thereof,
5 however, a thickness of the Au plating layer covering the planer
6 part 5 becomes thinner than a thickness of the Au plating layer
7 covering the lateral part 4. The reason why the Au plating layer
8 covering the planer part 5 becomes thinner is to prevent
9 degradation of connector performance due to gradual oxidation while
10 the planer part 5 is placed in less oxidation atmosphere than the
11 lateral part 4 comprising the contact 6 which are placed at
12 oxidation atmosphere due to electronic contact. The additional
13 reason is in that lowering the production cost by reducing amounts
14 of Au plating deposited on the planer part 5 having a wide area.
15 It may be possible to reduce degradation of the connector
16 performance by forming an insulation film on the planer part 5,
17 however, the above method should add the process for masking the
18 lateral part 4 which has already been applied with Au plating and
19 for depositing the insulation film thereon so that additional
20 materials and apparatus are necessitated thereby increasing the
21 production processes and failing to lowering the production costs.
22 The electronic connector terminal of the present invention makes it
23 possible to provide the Au plating on the planer part 5 at the same
24 time when the Au plating to the lateral part 4 is applied and the
25 thickness of the Au plating on the planer part 5 becomes thinner

1 than that of the lateral part 4, therefore, the terminal will be
2 provided in-expensively without the additional processes and the
3 additional materials.

4 In the present invention, when the liner plating layer is
5 applied, the liner plating layer between the terminal base material
6 2 and the Au plating layer may be the same thickness with the Au
7 plating layer, however, the liner plating layer may be formed such
8 that the thickness thereof covering the planer part 5 becomes
9 thinner than that of the lateral part 4. According to the present
10 invention, it is preferable to form the thickness of the liner
11 plating covering the planer part 5 thinner than that on the lateral
12 part in order to provide the terminals in-expensively.

13 Now, the method for forming the Au plating layer to the
14 electronic conductive terminal according to the present invention
15 will be described. Fig. 2 shows the situation in which the
16 terminal stacks 1 are plied and the carrier bars 9 are inserted
17 into the holes 8. The planer part 5 and the plane of carrier 3 of
18 the terminal in each of the terminal stacks 1 are adjacent each
19 other and only the planer part 5 and the plane of the carrier 3 of
20 the outermost terminal stack 1 are exposed freely to the plating
21 solution. Here, the plane of the carrier 3 is defined as the front
22 and back planes of the carrier 3 and the lateral part of the
23 carrier is defined as faces along to the thickness of the carrier
24 3. In the described embodiment in Fig. 2, the fixing member 10 is
25 disposed in a predetermined position of the carrier bar 9 after

1 inserting the carrier bar 9 into the holes 8 of the terminal stack
2 1 so as not to coming off from the carrier bar 9.

3 When the terminal stacks 1 supported by the supporting member
4 10 after insertion of the carrier bar 9 are dipped in plating
5 solution as is, Au plating layers are prevented to deposit on the
6 adjacent planer part 5 and the outermost planes of the carrier 3
7 except for the outermost planer part 5 and the plane of the carrier
8 3. In the present invention, the inventor found that the thinner
9 Au plating layer can be formed on the planer part 5 by dipping the
10 terminal stacks 1, moving the terminal base material such that the
11 planer part of each of the terminal base material is exposed to the
12 Au plating solution to immerse the plating solution allowing to
13 penetrate between the plied terminal stacks.

14 The above method will be described in detail by referring Fig.
15 3. The method for applying Au plating may include in the present
16 invention, such as, for example, an electric plating method using
17 an overflow-type plating bath; however, chemical plating methods
18 may not be excluded in the scope of the present invention. The
19 plating bath 11 comprises a plating-processing bath 13 in which an
20 anode 12 is disposed in the bottom thereof, a recover bath 14 being
21 placed around the plating-processing path 13 while recovering
22 plating solution overflowed from the plating-processing bath 13,
23 and a control bath 15 for sending the plating solution by pressure
24 to the plating-processing bath 13 and sending the plating solution
25 by pressure from the recovery bath 14 to the plating-processing

1 bath 13. The plating bath 11 is designed to keep the plating
2 solution level at a predetermined solution level while overflowing
3 from the plating-processing bath 13.

4 Next, the plural plied terminal stacks 1 are connected to a
5 cathode, and then are dipped into the plating solution in the
6 plating bath 11, and thereafter, the one end 9a of the carrier bar
7 9 being inserted through the terminal stacks 1 are caused to make
8 round trip movements along with a predetermined direction in a
9 predetermined frequency. For example, when the plural terminal
10 stacks 1 are plied using two carrier bar 9, one carrier bar may be
11 fixed and then only one end 9a of another carrier bar are caused to
12 make the round trip movements so that each of the terminal stacks
13 1 may be made the round trip movement. As shown in Fig. 3, when
14 the one end 9a is moved to the direction of the arrow A, the plural
15 terminal stacks 1 spread like a fan, and a region of the planer
16 parts of the terminal base material and a region of the plane of
17 the carriers are exposed to the plating solution. Further next,
18 when moved to the arrow B which is in the inverse direction to the
19 arrow A, the plural terminal stacks 1 spread like a fan again and
20 contact to their adjacent terminal stacks 1 such that the plating
21 solution on the surface of the planer part is extended as thin
22 layers to penetrate towards the entire surface of the planer part.
23 When the movements are repeated, the thin Au plating layer on the
24 entire planer part 5 may be deposited. The lateral parts are
25 always exposed to the plating solution, and then the thicker

1 plating layer than the planer part 5 and the plane of the carrier
2 3 may be formed.

3 In the present invention, the opposite end to the end 9a may
4 be caused to make round trip movements in the opposite direction of
5 the end 9a rather than moving only one end 9a. Alternatively, the
6 another carrier bar may be caused to make round trip movements
7 simultaneously such that faces exposed to the plating solution are
8 increased so as to form thin Au plating layer effectively on the
9 entire planer parts.

10 In the present invention, plural terminal stacks 1 are formed
11 by punching thin metal plate, followed by plying the plural
12 terminal stacks 1, further followed by inserting the carrier bar 9
13 to the holes, and further next the plural terminal stacks 1 are
14 supported to the carrier bar 9 by the fixing member 10 such that
15 the terminal stacks 1 does not come off from the carrier bar 9.
16 Then the terminal stacks 1 are washed by acid including, for
17 example, diluted HCL or diluted H_2SO_4 between 1 to 5 vol% and
18 further next are dipped into Ni plating solution to deposit the
19 liner Ni plating layer. In the steps of acid-washing and liner Ni
20 plating layer formation, the acid may be penetrated to the planer
21 parts 5 of the terminal stacks 1 and the liner plating solution may
22 also be penetrated to the planer parts 5 of the terminal stacks 1
23 by reciprocal movements of the carrier bar 9 such that the
24 thickness of the liner plating layer covering the planer part 5 may

1 be thinner than the thickness of the liner plating layer covering
2 the lateral part 4.

3 Fig. 4 shows the cross section of the terminal formed by
4 punching the thin plate followed by the Au plating. Here, Fig. 4
5 shows a part of the terminal in an enlarged format. Fig. 4(a)
6 shows the cross section of the terminal 16 viewed from the side
7 facing to the planer part 5 and Fig. 4(b) is the cross section of
8 the terminal 16 viewed from the side facing to the lateral part 4.
9 The terminal 16 shown in Fig. 4 comprises the Au plating layer 17
10 which is thicker on the lateral face side 4 and is thinner on the
11 planer part 5 of the terminal base material 2 formed by punched as
12 a desired shape. The ratio of the thicknesses of the Au plating
13 layer 17 is to be from about 10:1 to about 5:1 in preferred
14 embodiments.

15 In the present invention, the liner plating layer may be
16 disposed between the terminal base material 2 and the Au plating
17 layer 17. In such a case, a ratio of the thicknesses of liner
18 plating layers covering the lateral part 4 and the planer part 5
19 may be also from about 10:1 to about 5:1 in preferred embodiments.

20 The above described method comprises only the step of causing
21 the carrier bar 9 to make round trip movements along with the
22 predetermined direction at a predetermined frequency, and hence
23 additional production steps and apparatuses for depositing
24 insulation films are not required. In addition, amounts of Au
25 plating may be largely reduced when comparing with the case in

1 which Au plating with the same thickness is applied because the
2 thickness formed on the wide-area planer part 5 is to be from one
3 tenth to one fifth of the thickness of the lateral part 4.

4 5 Advantage of Invention

6 The electronic connector terminal according to the present
7 invention can be produced easily without requiring the additional
8 production process such as formation of the insulation film on the
9 planer part in order to protect the degradation of the connector
10 performance. The electronic connector terminal of the present
11 invention is also provided in lower costs due to reduced amount of
12 Au necessary for plating and further is able to maintain sufficient
13 contact pressure even when the terminals are placed in a narrow
14 width.

15 Hereinabove, the present invention has been explained based on
16 the particular embodiments depicted in the drawings, however, a
17 person skilled in the art may appreciate that exclusion of the
18 elements, omissions, other embodiments, and additions may be
19 possible in accordance with the teachings of the above description.
20 The true scope of the present invention will be determined only by
21 claims attached herewith.